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REMARKS

This is in response to the Office Action of 15 June 2004. Claims 1-8 are pending in the application, and Claims 1-8 have been rejected.

By this Response and Amendment, the specification has been amended to correct various typographical errors; Claims 1, 5, and 7-8 have been amended; new Claims 9-14 have been added; and Replacement Sheets are provided for corrected Figs. 3 and 7.

No new matter has been added.

In view of the amendments above and remarks below, Applicants respectfully request reconsideration and further examination.

About The Invention

The present invention relates generally to methods and apparatus for measuring overlay.

As used herein, "alignment", means the process of ensuring mask-to-substrate registration when a wafer is in an exposure apparatus (e.g., a projection apparatus). "Overlay", as used herein means the degree of after-exposure registration of a given level mask pattern and a subsequent level mask pattern. Alignment is carried out by means of mask alignment marks and substrate alignment marks. Alignment does not guarantee sufficient overlay because of error factors such as wafer stage accuracy, alignment measuring device accuracy, magnification error induced by substrate deformation, and pattern placement accuracy on the mask. Accurate and reliable overlay measurements are important to correct overlay errors.

The present invention provides methods and apparatus for measuring overlay, which do not require a stand-alone measuring system in addition to the exposure system, as are required in conventional approaches to measuring overlay. More particularly, the present invention relates to using the alignment-measuring device of an exposure system to also determine overlay error by

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generating an interference pattern through the illumination, with the exposure system, of a substrate overlay mark and a resist overlay mark.

Allowable Subject Matter

The Examiner states that "Claim 6 would be allowable if rewritten to overcome the rejections under 35 USC 112, second paragraph, and 35 USC 101 set forth in this Office Action and to include all of the limitations of the base claim and any intervening claims".

Applicants thank the Examiner for the indication of allowable subject matter.

Information Disclosure Statement

Applicant thanks the Examiner for considering the Information Disclosure Statement and for returning an initialed copy of the Information Disclosure Statement submitted by Applicant.

Objections to the Specification

The Examiner has objected to the specification, and states that on page 17 line 12 "b_{p10}(-1)" should read -b_{p11}(-1)-; and that on page 18 line 23 "Fig. 4" should read -Fig. 7-. The Examiner has required correction.

By this amendment, the typographical errors identified by the Examiner have been corrected. In view of the amendments to the specification, Applicants submit that the objection to the specification has been overcome.

Objections to the Drawings

The Examiner has objected to the drawings as failing to comply with 37

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CFR §1.84(p)(5). More particularly, the Examiner states that reference numeral 4 is missing from Fig. 3; and that reference character P_c is missing from Fig. 7. The Examiner has further objected to the drawings as failing to comply with 37 CFR §1.84(p)(5) for containing reference characters not mentioned in the description.

With respect to missing reference numeral "4" in Fig. 3, the specification has been amended at page 13, line 3, to correctly identify the beam splitter by the reference numeral "14". With respect to missing reference character " P_c " in Fig. 7, the specification has been amended at page 18, line 7, to correctly identify the composite substrate grating structure as " P_1 ". In view of this amendment to the specification, Applicants submit that this objection has been overcome.

With respect to the reference characters not mentioned in the description, the specification has been amended to include reference numerals 80-86, and the other reference characters identified by the Examiner have been removed from Figs. 3 and 7. Replacement Sheets are submitted herewith that include the corrections to Figs. 3 and 7. In view of the amendment to the specification and the correction of the drawings, Applicants respectfully submit that these drawing objections have been overcome.

Rejections under 35 USC §112, second paragraph

Claims 5-7 and 8 have been rejected under 35 USC §112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicants regard as the invention.

Claims 5 and 7 depend from amended Claim 1, and have been respectively amended to more clearly state that the alignment-measuring device recited in Claim 1, is either an on-axis, or an off-axis, alignment-measuring device. Claim 1 sets forth the method of measuring an interference pattern with the alignment-measuring device. Claim 6 depends from amended Claim 5. In

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view of the foregoing, Applicants respectfully submit that the rejection of Claims 5-7 under 35 USC §112, second paragraph, have been overcome.

Claim 8 has been amended in its preamble to delete the phrase, "one set of the following successive steps". Applicants respectfully submit that the amendment of Claim 8 overcomes the rejection under 35 USC §112, second paragraph.

Rejections under 35 USC §101

Claims 5-7 have been rejected under rejected 35 USC §101. The Examiner states that because the claimed recitation of a use, without setting forth any steps involved in the process results in an improper definition of a process.

Claims 5 and 7 depend from amended Claim 1, and have been respectively amended to more clearly state that the alignment-measuring device recited in Claim 1, is either an on-axis, or an off-axis, alignment-measuring device. Claim 1 sets forth the method of measuring an interference pattern with the alignment-measuring device. Claim 6 depends from amended Claim 5. In view of the foregoing, Applicants respectfully submit that the rejection of Claims 5-7 under 35 USC §101 have been overcome.

Rejections under 35 USC §102

Claim 8 has been rejected under 35 USC §102(a) as being anticipated by Wu (US Patent 6,278,116). Claim 8 has also been rejected under 35 USC §102(e) as being anticipated by Yin, et al., (US Patent 6,727,989).

Wu discloses using an image contrasting station, separate from the exposure system to measure reticle blind accuracy, pre-alignment accuracy, and overlay accuracy.

Yin, et al., disclose box-in-box overlay measurement marks, where one

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box is placed at a different focal plane from the other.

Claim 8 has been amended to make clear that determining the overlay is accomplished by measuring an interference pattern with an alignment-measuring device that is part of the exposure system. Claim 8 further recites that the substrate alignment mark, the reference mark, the substrate overlay mark, and the resist overlay mark are each periodic structures. Neither Wu, nor Yin, et al., disclose, suggest, or provide motivation for the claimed method of determining overlay by measuring an interference pattern with an alignment-measuring device that is part of the exposure system where the both the alignment and overlay marks are periodic structures. In view of the foregoing, Applicants respectfully submit that rejections 35 USC §102(a) and 102(e) have been overcome.

Rejections under 35 USC §103(a)

Claims 1-3 and 5 have been rejected under 35 USC §103(a) as being unpatentable over Everett, et al., (US Patent 5,808,742) in view of Yashita, et al., (US Patent 5,252,414). Claims 4 and 7 have been rejected under 35 USC §103(a) as being unpatentable over Everett, et al., (US Patent 5,808,742) in view of Yashita, et al., (US Patent 5,252,414) and further in view of Hirukawa, et al., (US Patent 5,402,224).

Independent Claim 1 has been amended to more clearly set forth its limitations. The limitations of amended Claim 1 do not appear to be met by the cited references. For example, Claim 1 is directed to overlay measurement, not the alignment measurement of Everett, et al. Further, Everett, et al., do not disclose illuminating a substrate overlay mark and a corresponding resist overlay mark in order to determine the overlay error, rather Everett, et al., discloses alignment of a mask to a wafer. The combination of Everett, et al., and Yamashita, et al., do not suggest or provide motivation for illuminating a resist overlay mark along with a substrate overlay mark to provide an interference pattern from which overlay error is determined. In view of the foregoing,

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Applicants respectfully submit that the rejection of Claim 1 under 35 USC §103(a) has been overcome. Applicants further submit that the rejections of Claims 2-5 and 7, which depend from amended Claim 1, have also been overcome.

New Claims 9-14

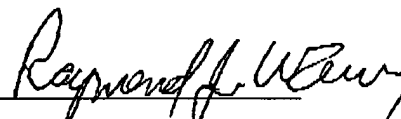
New Claims 9-14 depend, directly or indirectly, from amended independent Claim 8. Claims 9-14 are directed to various aspects of the exposure system, the alignment-measuring device, and the alignment and overlay marks. Support for these Claims can be found in the specification at pages 3-6.

Conclusion

All of the objections and rejections in the outstanding Office Action of 15 June 2004 have been responded to, and Applicants respectfully submit that the pending Claims 1-14 are now in condition for allowance.

Applicants respectfully request that a timely Notice of Allowance be issued in this case.

Respectfully submitted,

By 
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Hillsboro, Oregon